

REQUEST FOR RECONSIDERATION

Present independent Claim 10, as amended herein recites continuously feeding an aqueous solution of a monomer mixture into a mixing kneader having at least two axially parallel rotating shafts to convey the monomer mixture in piston flow from an upstream end of the mixing kneader to a downstream end of the mixing kneader. Applicants submit that those of ordinary skill in the art readily recognize that the feed flow in a mixing kneader having axially parallel rotating shafts occurs in a piston flow manner that minimizes back flow and back mixing at least because the transporting elements of the parallel rotating shafts function to force any material present inside the mixing kneader to a downstream end thereof.

Applicants submit herewith a description of List mixing equipment having axially parallel rotating shafts. The List-ORP rotating processor data sheet submitted concurrently herewith indicates that this mixer works “in a continuous plant [and] there is a slow axial conveying which is largely independent of lateral mixing” (see underlined text on page 2). The List mixers are explicitly disclosed on page 6, lines 33-36 of the present specification which also discloses several publications wherein the List mixers are used including WO 97/12666.

The Office rejected the claims as anticipated or in the alternate as obvious in view of a patent to Tsubakimoto (U.S. 4,625,001). Tsubakimoto describes the prior art process as follows:

The method of this invention is entirely different in operating principle from the method of Japanese Patent Laid-Open No. SHO 56(1981)-32514 which causes the materials to be moved in the manner of piston flow from the entrance to the exit. The aqueous monomer solution introduced into the vessel is uniformly mixed with the finely divided water-containing gel polymer particles and, in that state, subjected to polymerization and part of the produced polymers discharged out of the vessel. As a result, the amount of the water-containing gel polymer retained inside the reaction vessel is large for the amount of heat generated. Thus the removal of heat is easy.

In contrast, in the case of the method which involves the movement of materials in the manner of piston flow, the removal of heat is difficult. An attempt to enhance the productivity of the polymerization, therefore, has a fair possibility of elevating the temperature of the material and degrading the quality of the product. (column 8, lines 11-29).

Therefore, Tsubakimoto describes the prior art process as one that does not exhibit piston flow and instead utilizes substantial mixing including back-mixing and back-flow. Applicants submit that the presently claimed method, wherein the axially parallel rotating shafts convey the monomer mixture in piston flow is not anticipated or rendered obvious by Tsubakimoto because Tsubakimoto explicitly states that such a piston flow does not occur in the prior art process and that such piston flow is not desirable. Applicants submit the presently claimed invention is novel and not obvious in view of Tsubakimoto.

A further indication that the process of Tsubakimoto is different from the claimed process may be obtained from a comparison of the Examples of the present application with the Examples of the prior art. Example 1 of Tsubakimoto has a residence time of 45 minutes. In contrast, the residence time of new dependent Claims 30-32 is 30, 20, and 10 minutes, respectively.

Further, the shaft of Tsubakimoto is disclosed as one that may be “a sigma type, S type, Banbury type and fish-tail type” (column 4, lines 12-14). Tsubakimoto does not disclose an arrangement of axially parallel rotating shafts that contain L- or U-shaped attachments that may be close-clearance as per new dependent Claims 26-29.

Applicants submit that Tsubakimoto did not contemplate the present invention because Tsubakimoto discloses the benefits of back-mixing (e.g., stable heat generation) but does not disclose that improved polymerization may be obtained on the surface of the polymer by limiting as much as possible unreacted monomer present on the polymer surface by using a high shear arrangement of axially orientated screws.

Applicants submit a method that uses piston flow is cannot be anticipated or rendered obvious by Tsubakimoto and respectfully request withdrawal of the rejection.

The Office further rejected the claims as anticipated or obvious in view of a patent to Irie (U.S. 4,920,202). As was discussed above for Tsubakimoto, Applicants submit that Irie does not disclose a process wherein back-mixing is reduced by using piston flow. Applicants submit that Irie does not disclose or suggest processes wherein a monomer mixture is extruded in a mixing kneader in a piston flow manner that reduces back flow and back-mixing. In fact, in the Examples of Irie it is disclosed that the prior art mixer includes the use of “sigma” blades (column 6, line 52).

Applicants submit that it is readily evident to those of ordinary skill in the art that the mixing kneader of the present claims is carried out in a different manner (e.g., via piston flow) and must give a different product (e.g., one that has less residual monomer) than the product obtained from the mixing kneaders and/or mixing equipment of the prior art relied upon by the Office.

With respect to the new dependent claims limiting the residence time of the mixture in the kneader, the Examples of Irie describe reaction times of a total of 60 minutes (column 6, line 64). Unlike Irie, the presently claimed process may provide a polymer having a reduced residual monomer content even under short residence time conditions (see new dependent Claims 30-32).

Like Irie, Tsubakimoto discloses a process which requires significantly longer residence times of the monomer mixture inside the mixing kneader. Applicants submit that concurrently achieving low residual monomer content and low residence time may be a function of the type of axially oriented rotating shafts present in a mixing kneader recited in the present claims. The axially oriented rotating shafts of the claimed invention are able to minimize back flow and back mixing and more quickly transport the polymerizing gel

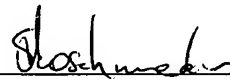
material through the mixing kneader without sacrificing residual monomer content. Thus piston flow functions differently than the prior art methods and may provide a different polymer than the prior art methods. Applicants submit that the rotating shafts of the presently claimed invention may necessary to obtaining piston-type flow and consequently are critical to obtaining low residual monomer content at low residence time.

Applicants submit that the prior art's disclosure of longer residence times, shaft elements such as "sigma blades" and "fish-tails", etc. indicates that the prior art contemplates substantial back mixing and back flow in order to achieve polymerization and not the piston flow of the claimed invention.

Applicants therefore submit that the presently claimed invention is novel and not obvious in view of the prior art at least because the prior art does not recognize the significantly superior performance that can be achieved when certain elements of rotating shafts are used to obtain piston-type flow in a mixing kneader thereby lowering residence time without sacrificing residual monomer content.

Respectfully submitted,

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